MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

EPM1016 – INSTRUMENTATION AND MEASUREMENT TECHNIQUES

(TE, RE, BE)

31 MAY 2016
2.30 P.M. – 4.30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

a) In a spring controlled permanent magnet moving coil ammeter the pointer moves through an angle of 45° when current to be measured is changed by 20mA. Determine the instrument sensitivity.

[2 marks]

b) The unknown resistance is determined by expression:

$$R_X = \frac{R_2 \times R_3}{R_1}$$

Where R_1=900±0.5% Ω, R_2= 900±0.8% Ω and R_3=825±0.6%Ω. Determine the magnitude of Rx and limiting error in percentage.

[3 marks]

c) Voltmeter X (given internal resistance, R_v =200kΩ) is used to measure the voltage across R_B as shown in the figure Q1. Determine the

(i) voltage across R_B without any meter connected. [2 marks]

(ii) voltage across R_B with voltmeter X connected. [3 marks]

(iii) % error. [2 marks]

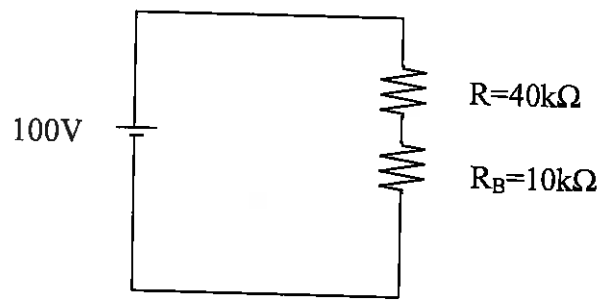

Figure Q1

d) A Permanent Magnet Moving Coil (PMMC) ammeter has a 120-turn moving coil with a length of 4cm and a width of 1.5cm. The magnetic flux density in its air gap is $B = 0.8T$. When a maximum current of 5mA flows through the coil, the pointer deflect by 90°.

(i) Determine the deflecting torque. [2 marks]

(ii) For both spring control and gravity control methods of balancing, determine the deflecting angle if 3.5mA of current flows through the coil. [3+3 marks]

(iii) With a circuit diagram, explain how a shunt resistor R_{sh} can be used to extend the current range of the ammeter to 2A. Assume the resistance of the moving coil is $R_M = 10\Omega$. [5 marks]

Question 2

a) A three-phase, 440V generator supplies to a star connected load with impedance 60+j15 Ω/phase.

(i) Draw the three- phase circuit. [3 marks]

(ii) Calculate the line current and phase current. [3 marks]

(iii) Calculate the power factor. [2 marks]

(iv) Given that the power factor as in (iii), find the readings of the two wattmeters which are connected for power measurement [8 marks]

(v) Verify that the sum of the readings in (iv) gives the total load power. [3 marks]

b) Three similar coils each having a resistance of 25Ω and an inductance of 60mH are connected in *Mesh* to a 3-phase, 60 Hz supply with 400V between lines. Calculate the line current and the total power absorbed. [6 marks]

Continued .....

Question 3

a) State the required conditions to balance an AC bridge.

[4 marks]

b) Figure Q3 shows a parallel-resistance capacitance bridge with a standard capacitance of C_1 of $0.01\mu F$. The bridge is balanced when R_1=24kΩ, R_3=48kΩ, and R_4=1kΩ at a supply frequency of $50Hz$. Determine the resistive and capacitive components of the measured capacitor. Also, find its dissipation factor (D-factor).

[8 marks]

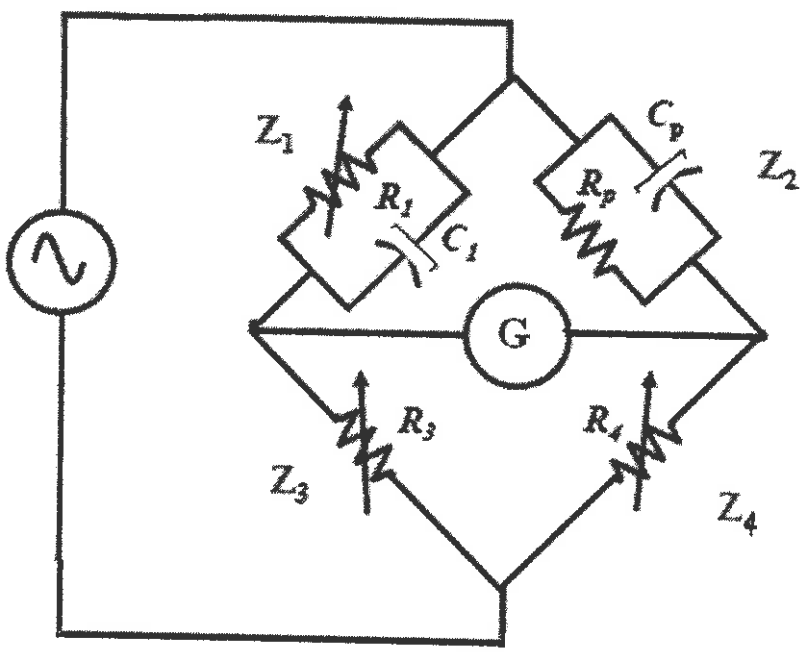

Figure Q3

c) Sketch the circuit diagram of a Hay Inductance Bridge. Derive the equations for the resistive and inductive components of the measured inductor.

[13 marks]

Continued .....

Question 4

a) A bridge circuit is used to measure the output of a strain gauge having a resistance of 110Ω under zero strain conditions. R_2 and R_3 are both 100Ω, and the galvanometer resistance is 75 Ω. If the gauge factor is 2, determine the galvanometer current when the strain is $\varepsilon = 300\ \mu m/m$ for a voltage source of 6V.

[13 marks]

b) An LVDT gives an output of 5mV across its terminals when the core has a displacement of 1mm. If the LVDT is connected to a 10V voltmeter with amplification factor of 50, determine the

(i) sensitivity of the LVDT. [3 marks]

(ii) sensitivity of the whole setup. [3 marks]

(iii) If the scale of the mili-voltmeter has 50 divisions and the scale can be read accurately up to 1/5 of a division, what is the resolution (in mm) of the instrument? [6 marks]

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